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The Environmental Management System Framework of the Industrial Facility: A Case Study in the UAE Aluminium Industry

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Abstract

An Environmental Management System (EMS) manages the environmental aspects of the industrial sector by minimizing, controlling and mitigating the impacts of the industry. The United Arab Emirates (UAE) as a world leader in the aluminium industry has introduced EMS in its aluminium industrial sites to manage the environmental impact of this energy-intensive and environmentally challenging industry. This paper investigates the sustainability and environmental performance of the aluminium manufacturing and production process by analyzing the efficiency of the EMS in controlling the impact of the industrial processes on the environment. By analyzing gaps in implementation of EMS and understanding the strengths and weaknesses of the framework already existing at the case study sites, this study proposes an efficient framework for implementing EMS for the context of aluminium industry in the UAE. The proposed EMS framework is validated qualitatively and quantitatively to ensure its applicability, efficiency and usefulness. The paper recommends linking environmental planning and management outputs for the aluminium industry through a life cycle approach

Keywords: Environmental management system; Aluminium industry; EMS framework

Introduction

Industries started investigating the impact of their production processes on the environment and coming up with approaches to reduce and mitigate these impacts since the 1990s [1,2]. An Environmental Management System (EMS) is considered an effective tool for controlling and mitigating the impacts of industrial processes and ensuring cleaner production methods [3-6]. Whether it is an industry in-house established EMS, a local EMS regulation or the ISO 14001 EMS standard, the efficient implementation of an EMS helps in mitigating the environmental impact of industries [7-9]. The aluminium industry is one of the most important construction related industries. In fact, aluminium usage in buildings and construction projects positively affects the UAE's GDP and increases its economic prosperity Gulf Aluminium Council [10]. However, this industry is associated with a number of environmental and sustainability challenges such as intensive energy usage, emissions and air pollutants, waste generation and extensive resources consumption and management. The application of EMS is assessed in this paper to understand its ability to mitigate the environmental impacts of the aluminium industry, where areas of weaknesses and strengths are identified [11]. Sajwani and Nielsen [11] stated that the implementation of EMS in the United Arab Emirates (UAE) aluminium industry is heavily affected by regulatory compliance and enforcement gap, transparent leadership, accountability, and human factors among other factors. This study follows on from the latter paper and proposes a framework for the implementation of the EMS in the UAE aluminium industry which is produced to optimally suit this environmentally intricate industry.

The ISO 14001 standard (Environmental Management) can be considered a voluntary approach to environmental regulation as there is no legal obligation to obtain the certification. This EMS allows plant operators to work under a systemic framework that regularly monitors, evaluates, keeps records and continuously improves how tasks are performed. Darnall et al. [12] and Haque [13] stated that although the regulatory bodies do not mandate certification to the

ISO 14001 Environmental Management System Standard, there are many companies world-wide that voluntarily continue to adopt the ISO 14001 standard. The main drive behind adopting ISO 14001 by these companies is to enhance their environmental image, develop competitive advantage, and be socially responsible. Potoski and Prakash [14] argue that voluntary environmental programs, such as the ISO 14001 Environmental Management System, are considered essential instruments of environmental policy and management at the global scale.

Despite all the benefits that the ISO 14001 EMS Framework offers, there is an on-going debate in literature about the effectiveness of this voluntary approach in managing environmental issues of the plant. Ziegler and Rennings [15] reported that in German companies, being EMS certified does not directly affect the environmental performance. In addition, King and Lenox [16] presented an argument suggesting that industry self-regulation by using voluntary approaches for environmental management is difficult without sanctions. They raised the question of whether profit-making industries can have effective environmental management by using the voluntary approach to environmental regulation. They concluded that it is difficult to establish and maintain industry self-regulation programs such as the ISO 14001 EMS particularly due to elevated poor environmental performance of industry. When the regulation comes from within the company or the industry itself, it is often not taken seriously. It takes

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a strong regulator to enforce environmental regulations; otherwise, self-commitment of the environmental management may have its downsides including producing biased and false information about the industry environmental performance, especially if the regulation comes from within.

The main shortcoming of the current EMS systems is its inability to effectively manage environmental issues and concerns of the industry. Some of the key barriers to proper implementation of any EMS are communication gaps, lack of resources whether human or financial, along with the proper understanding of how EMS is integrated with the company's operation [17]. This can be attributed to the following three defects: organizational, system and human aspects. According to Rowland-Jones et al. [18] and Rohati et al. [19], the current environmental management systems applied in organizations, whether they are BS EN ISO 14000:1996 or EU Eco-Management and Audit Scheme (EMAS) does not directly comment on the environmental performance. Unskilled labor, weak management commitment and poor standards are the main problems in the implementation of the EMS system. On paper, the EMS may seem as a powerful tool for effective environmental management; however, the system has been called a "paper tiger". Enroth & Zackerisson [20] mention that in many cases there are ample papers support the EMS but, there is no actual implementation of the EMS. The authors point out that green economies and integrated environmental performance is the future for industries and those companies which cannot keep up with the advance of the integrated environmental management will no longer exist.

The UAE is fairly young in the field of environmental compliance and implementation of environmental management and assessment to its projects, industries and facilities. The country is undergoing a phase of expansion and maturation, which places huge pressure on the sustainability and environmental resources. It is important to balance economic development with sound environmental practices to preserve available resources and create a sustainable way of living. The aluminium industry in the UAE is reaching aspiring global economic, productive and commercial standards; however, the question remains whether the environmental management system in this industry is up to the global environmental standards. In order to properly assess the implementation of the EMS within the UAE aluminium industry, the factors that affect its performance should be studied in order to enhance EMS application and propose effective framework for its implementation. The advantages of improving the environmental management application include.

Positively affecting the quality of individual's lives, including employees and the general public, in terms of environment, health and safety. Reduced air emissions mean less air pollution and better environmental accountability for the company's activities.

Reducing volume of waste and enhancing utilization of resources will save cost on the company and will eliminates unnecessary processes. This means efficiency in water usage, waste reduction, purchasing and transport. Improved environmental management leads to improved production efficiency by implementing lean manufacturing concepts.

Socio-economic benefits for secondary industries emerging from sustainable aluminium production and enhancing other recycling and pollution reduction industries by generating jobs through the implementation of circular economy concepts.

Improving environmental management implementation ensures compliance with basic regulatory requirements and enhances company image. Adoption of sound environmental management practices

demonstrates a company's responsibility towards its stakeholders, whether regulatory authorities, the public or its clients. There are local environmental standards within the UAE such as Abu Dhabi [21] Environment, Health and Safety Management Systems (AD EHSMS) which places stronger emphasis on health and safety elements rather than the environmental elements. The AD EHSMS is expected to become mandatory in the future.

Environmental management at industrial projects should be closely integrated in the process operations, management requirements and work culture. This would generally require working at different levels such as the individual level, organizational level, and management level. Awareness of the EMS performance related factors certainly plays an essential role in the successful implementation of EMS standards and reflects directly on the reputation of the facility. Improving the EMS at industrial projects helps ensure sound production, related construction and operation practices [22,23].

Methodology

The aim of the study is to propose a framework to enhance the implementation of the EMS in the UAE aluminium industry. This aim can be achieved through the realization of four objectives as follows:

Analyzing factors affecting EMS.

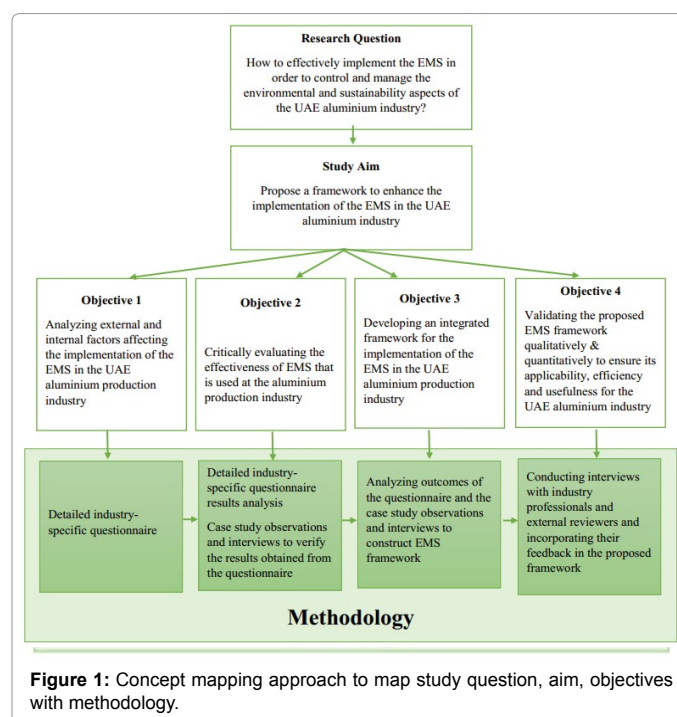
Evaluating effectiveness of EMS.

Developing the EMS framework and validating it.

A detailed industry-based questionnaire, case study observations and interviews are conducted where primary descriptive research method is used. Figure 1 represents the concept mapping approach to map the study question, aim, objectives and methodology.

Statistical approach

The questionnaire was undertaken at two industrial sites in the UAE, where the targeted stakeholders were divided into two categories:



(A) Top management and senior engineers and (B) The operational laborers. An estimated population number was calculated to determine the optimal sample size for meaningful results and the stratified random sampling method is employed. Hofmann and Stetzer [24] recommend the stratified random sampling because it provides a varied cell that contains different construction roles: Managers, engineer, forement, etc and can provide accrued outputs and assessment of the respondents. In the realm of environmental management field research, Sarkar et al. [25] recommend this sampling method as well where it can present large different units of the desired population and diverse elements to save money and time in collecting data. The measurements within the strata have lower standard deviation and therefore can achieve lower percentages of error; in addition, measurements are more manageable within the strata.

Random samples from within each group were selected. Under the 95% confidence interval for a population of about 6750 employees and a margin of error of about 5%, a representative sample size was calculated to be around 364 employees. The actual gathered responses were obtained from 371 employees. The questionnaire structure comprised of three main sections which are population demographic section, Environment Management System (EMS) evaluation through Likert Scale System, and lastly, the opinion-based EMS evaluation. Most of the questions are directly related to the environmental performance, compliance, training and leadership involvement. Section 3 focuses on opinions collected from the respondents on how EMS framework is being implemented at the facility. Data verification was performed through Pearson Chi-square goodness of fit test, which is applied to categories of data to establish if they are different. Chi-square test was chosen because it provides a 5×5 (or less) category analysis that allows examining all the 5 variables in the Likert scale received responses using statistical significance, correlation and logical associations [26]. The statistical assumptions are that $\alpha=0.05$ and an asymptotic significant value is the Probability-value (p-value) which is 2-sided. Cases and conditions for statistical analysis are:

A. If $p\text{-value} < 0.05$ then the factor is “statistically significant”, which means respondents’ status is Dependent on (or Not Independent of) this particular factor.

B. If $p\text{-value} > 0.05$ then the factor is “statistically insignificant”, which means Respondents’ status is Independent of (or Not Dependent on) this particular factor.

The Pearson chi-square goodness of fit test equation used to interpret the data in a (5×2 table) is the following:

$$\chi^2 = \sum_i \sum_j \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Where,

O=Observed frequency.

E=Expected frequency.

Σ=Summation.

X2=Chi-square value.

The Statistical Package for the Social Sciences (SPSS) is used for data analysis. The SPSS package compares data sets easily, saves processing time and allows for complex statistical data analysis [27]. Case study interviews and observations are used to strengthen the outcomes and confirm the results obtained via the questionnaire. A combined on-

site data collection, observation and interviews can present qualitative evidence. Case studies can also be used to provide a description, test theory or generate a theory. The objectives of the case study are as follows:

- Validate the questionnaire results.
- Determine root causes of EMS weaknesses in the UAE aluminium industry.
- Investigate the reaction of managers and end-users in regard to environmental performance of the facility.
- Formulate the basis of the framework for enhancing the implementation of the EMS in the aluminium industry.

The questionnaire was distributed to the aluminium industry staff, distinguishing two main categories, managers and operational staff. Pearson chi-square goodness of fit test was used to differentiate between dependent (statistically significant) and independent (statistically insignificant) factors affecting the implementation of EMS in the UAE aluminium industry.

Following the questionnaire results analysis, a case study was conducted to verify and confirm the results obtained through the questionnaire. The outcomes from both the questionnaire and the case study were used to formulate the basis of the proposed framework for enhancing the implementation of EMS in the UAE aluminium industry.

Results and Discussions

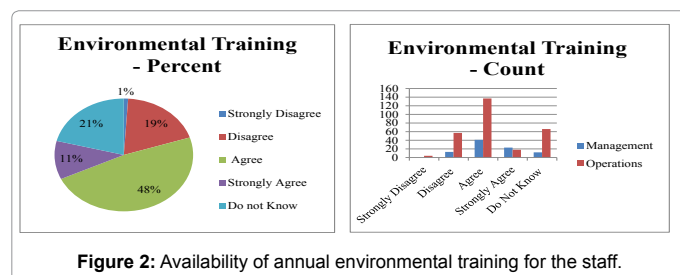
Few parameters of the questionnaire are discussed thoroughly in the section below while the entire questionnaire results are summarized in Table 1.

Environmental training at the facility

Training is an important pillar of an EMS. It is the main means of communicating the EMS aims, objectives and execution needs. According the Daily and Huang [28] environmental training at the facility is mainly used to educate staff about the main environmental aspects, impacts and mitigation measures relevant to their industry. The respondents were asked whether the facility conducts regular annual environmental training for the staff. Figure 2 shows that a great percentage of the respondents (48% agree, 11% strongly agree) agree that the facility conducts regular annual environmental training for their staff. This is an excellent percentage; however, if compared to the obvious lack of awareness and communication, it in fact unravels more deficiencies.

The question whether the facility conducts regular annual environmental training for their staff did not explore the quality and quantity of environmental training provided at the facility. Refresher environmental training for current staff, induction for new joining employees and specific environmental training for contractors involved at the workplace share an equal level of importance when it comes to delivering high level industrial EMS training. 21% of the respondents answered that they don't know whether annual environmental training is provided and 19% respondents disagree with the statement that there is regular annual environmental training conducted at the facility. It is evident that if an in-depth environmental training is provided to all staff then the environmental awareness at the facility would also rise, positively influencing all other operational functions.

By applying chi square test to the set of responses obtained from management and operations staff on this question, a significant dif-



ference is noticed. The chi-square statistic is 28.8263. The p-value is <0.00001 which means that the result is significant at $p < 0.05$. This again stresses out that the gap between management and operations staff is large and these two populations and their views are not the same. Figure 2 shows that most management and operational staff agree that there is regular environmental training conducted at their facility, while a fair number of operations staff either “do not know” or “disagree”.

EMS and environmental compliance improvement

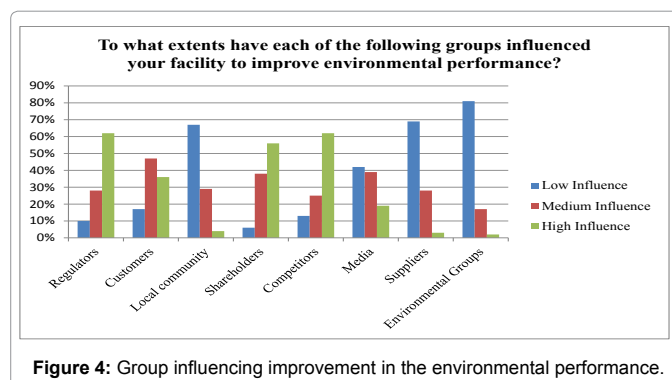
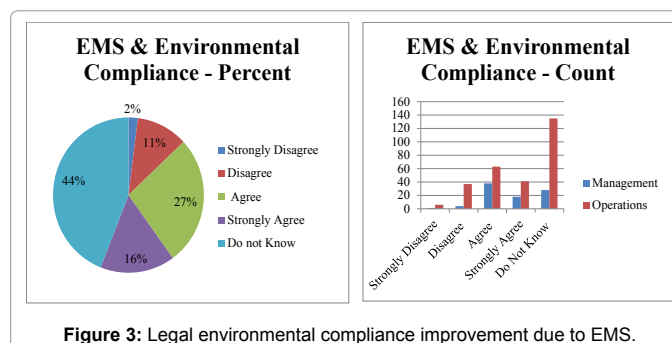
One of the most desired outcomes from implementing the EMS is meeting the legal requirements and improving the regulatory compliance. The respondents were asked whether EMS implementation improves legal environmental compliance with the regulator. Figure 3 presents that the majority of respondents (44%) are uninformed whether EMS has improved the legal compliance with the regulator, while collectively 43% (27% agree and 16% strongly agree) of the respondents believe that such legal environmental improvements has been proven due to implementation of the EMS at the facility. Figure 3 further illustrates the management and operations staff responses in relevance to improved environmental compliance due to EMS implementation. By applying the chi square test, it is evident the management and operations staff responses are different with regards to environmental legal compliance and EMS implementation. The chi-square statistic is 20.7359. The p-value is 0.000357 which means that the result is significant at $p < 0.05$.

Liu et al. [29] explain that environmental compliance should be considered in the operational facilities to enhance the compliance level. To support this, Morrow and Rondinelli [30] illustrate how the main reason that CEMS (Continuous Emissions Monitoring Systems) are installed at the stacks in many operational plants is to monitor emissions and ensure they are not exceeding the regulatory limits. In the end of their research work, the authors suggest that EMS should be utilized closely in a framework that achieves and guarantees legal environmental compliance in way that meets the business plans and the objectives of the organization.

Groups influencing environmental performance

Question in Figure 4 examines the external stakeholders that influence the industrial professionals to act and operate with respect to the environmental matters for short and long term. Figure 4 illustrates that many respondents believe that there exists a major absence of environmental groups and local community role in influencing the environmental performance at the operational plants. To illustrate the employees indicated a low influence response as 81% and 69% for environmental groups and local community respectively in which these results display a lack of involvement and communication between these groups and the industrial facilities.

Florida and Davison [31] conducted a research work that explores the internal and external factors affecting the implementation of EMS



inside the operational organizations. They conclude that poor involvement of environmental society groups has a significant impact on the implementation of the environmental system. The authors mention that environmental society groups present an outsider point-of-view that reflects the community's environmental needs. Such point views aid industrial sectors in designing a specific framework that covers the current environmental challenges in the surrounding area. In addition, Figure 4 reflects a positive indication and perspective about the regulator's influence where most of the respondents (62%) selected regulators as one of the highest influencing groups on industries. This shows an optimistic view of how legislations and regulations can enhance the environmental performance at aluminium operational plants. Telle and Larsson [32] and Bye & Klemetsen [33] believe that environmental laws and regulations are factors affecting the process of environmental compliance at the aluminium manufacturing facility. The authors illustrate that most of the operation plants tend to comply with regulations to avoid legal actions or fines that can be issued from government authorities in case of non-compliance. The regulators typically ensure compliance by conducting regular audits and inspection for the aluminium manufacturing plants. Moreover, the authors highlighted that compliance with the legislations will encourage the industrial firms to have positive competitive advantage between them in a way that makes their operational processes greener and more sustainable.

Environmental improvement motivation factors

Govindarajulu and Daily [34] and Wehrmeyer [35] believe that environmental motivation is an important factor for all employees from management to operational level. Here, the motivational drive to implement EMS can differ from one operational facility to the other. For example, the authors mention that many of the operational facilities adopt the EMS to become ISO 14000 certified and this recognition aids in gaining a better reputation in the local and international markets. This political/economic drive is reflected in Figure 5 where 89% of the

respondents selected compliance to regulatory system as the main motivational factor for implementing the EMS. In addition, the responses show that having new products and services can be another important environmental motivation factor that helps the organizations attract more customers, especially those who desire to have more sustainable products incorporated in their operational activities. Unfortunately, the gaps between the Environmental Non-Governmental Organizations (NGOs) and industrial companies arise again in Figure 5 where 65% of the respondents do not see any importance of improving the NGO relationship as environmental motivation for their facilities. However, Wiengarten et al. [36] suggest that the real motivation for the industrial companies should come from an ethical standpoint that considers the safety and health of the employees and the surrounding area. The authors explain that the orientation of management plays a critical role in the adoption of EMS implementation where ethical motivation acts as a trigger that initiates the ISO 14000 Environment Management System. In general, Figure 5 explains that industrial firms do invest in obtaining ISO14001 certification to enhance their operation's environmental performance; however, this is often done for the wrong reasons. EMS is incorrectly utilized if senior management consider ISO 14001 certification as a display of a functioning EMS and exceptional environmental performance.

External and Internal Factors Affecting EMS

Figure 6 ranks the external factors affecting the implementation of the EMS while percentages represent the number of occurrences the factor has occupied the rank. Respondents have ranked bureaucratic work as the highest external factor affecting the implementation of EMS and it occupied the first rank 38% of the time. Other factors mentioned in the Figure 6 occupied their ranks from 1-7 with different percentages of occurrence. According to Pérez et al. [37], bureaucratic practices have a major impact on the EMS implementation, especially if they occur at the communication and approval system in which they can delay the processes and de-motivate employees.

Figure 7 explains the ranking of internal factors affecting the implementation of the EMS while percentages represent the number of occurrences the factor has occupied the rank. Around 47% of the respondents indicate that inconsistent top management support is the top internal factor affecting the implementation of EMS. According to Christmann [38] and Boiral et al. [39], the most important internal practice to implement EMS is the demonstration of the environmental leadership which should be raised from the top management inside the workplace. The author believes that "best practices" in environmental

management always requires "a lead by example" approach where employees can follow someone who is committed to sound environmental practices at the operation plant. As such, practicing environmental leadership is crucial because it does not only train the employees to be compliant with environmental regulations but it also encourages the operational staff to enhance their professional skills to stay competitive through the application of EMS. This is why the author suggests that environmental leadership adoption is an influential key internal factor for EMS implementation.

Survey results display major gaps in the EMS implementation process at the aluminium industry in UAE. Lack of awareness on issues related to EMS implementation was evident in almost all responses along with a weak enforcement of the regulations. The most interesting result obtained is that respondents exhibited a tendency for improvement and a quest for knowledge about environmental requirements. Moreover, inconsistent top management support was ranked as the number one internal factor affecting the implementation of EMS, suggesting a leadership gap. It is worth noticing that bureaucratic work was ranked as the number one external factor affecting the implementation of EMS, highlighting the complexity of the external relations with government authorities.

Most of the respondents are male and also possess a Bachelor's degree and work in manufacturing and operations fields. Thus, the targeted population is achieved where most of the respondents are the technical staff working within the operational units of the UAE aluminium industry.

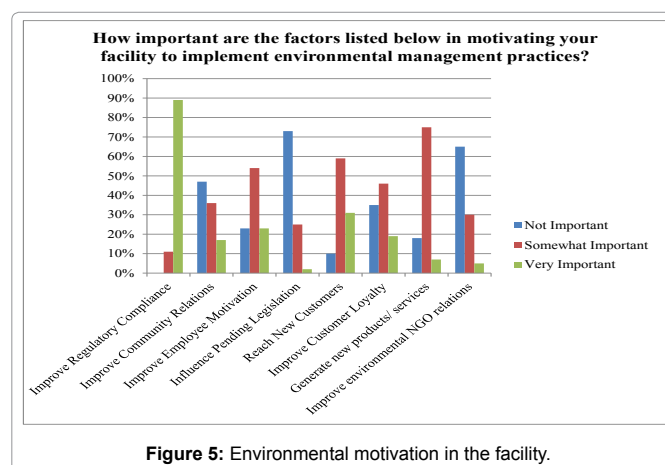


Figure 5: Environmental motivation in the facility.

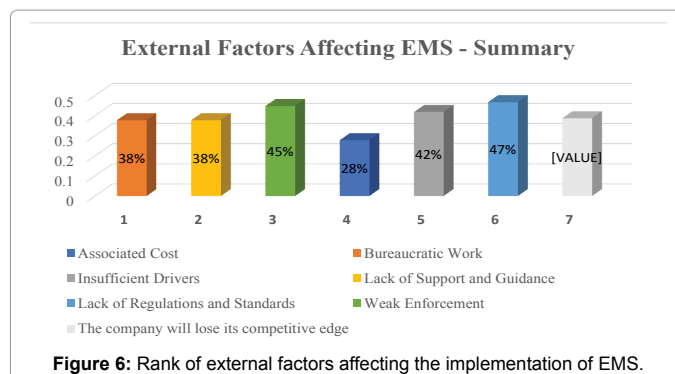


Figure 6: Rank of external factors affecting the implementation of EMS.

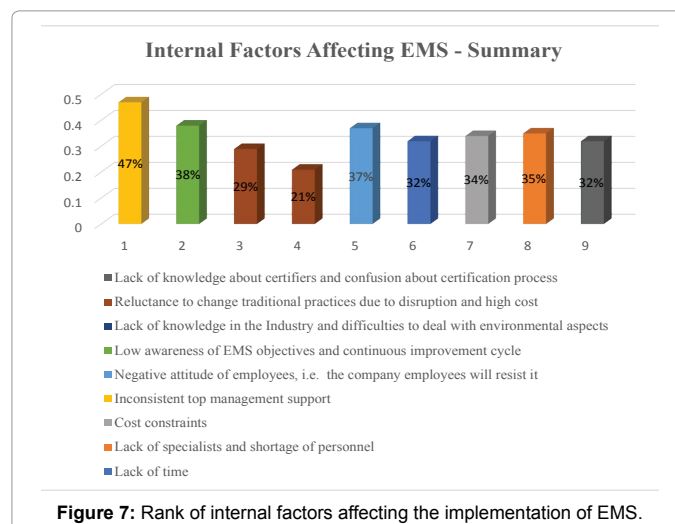


Figure 7: Rank of internal factors affecting the implementation of EMS.

Significant Factors (p-value<0.05)	Independent Factors (p-value>0.05)
Lack of awareness on issues related to EMS implementation and weak enforcement of the regulations.	1. Environmental policy is visible, accessible to all staff and well communicated.
Inconsistent top management support and absence of transparent leadership.	2. Lack of accountability in fulfilling the set objectives and targets.
Bureaucratic work affects implementation of EMS.	3. Facility benefits from the marketing and branding in adopting the EMS by increasing the number of clients and expanding business.
Environment Training affects the implementation and awareness of EMS.	4. Targets and objectives for all the significant environmental aspects including air, water, solid waste, hazardous waste and noise.
Weak communication between industrial companies and the non-governmental organizations (NGOs) hinders EMS external outreach.	-
Lack of funding affects the implementation of EMS.	-

Table 1: List of statistically significant factors and independent factors affecting the implementation of EMS in the UAE aluminium industry.

On a positive note, the questionnaire shows that the surveyed employees see the value of implementing the EMS on the technical aspects, such as reduced environmental impacts or the branding, and marketing aspects, such as enhanced company image. Additionally, the majority of respondents highlighted that they do receive environmental-based training and companies do offer environmental training courses. However, the quality of the provided environmental training is questionable as it has failed to significantly increase employees' environmental awareness on EMS related issues. It can be inferred that the provided training is not specific enough or not tailored to the employees' needs.

Many employees lack the basic knowledge regarding the existence of the EMS at their facility. This can be attributed to the lack of motivation for environmental improvements. Moreover, low awareness on environmental objectives and continuous improvement cycle settles for second place as the most influential internal factors affecting the implementation of EMS. The environmental knowledge and awareness of employees is often low and this can be attributed to the high operational staff turnover rates at industrial sites; which emphasize the importance of continuous awareness and job-specific environmental training.

The questionnaire also highlighted other organizational defects and challenges in implementing the EMS such as the lack of funding and the absence of transparent leadership. There is also a need for the employees working on site to get a better understanding of the internal and external factors affecting the implementation of EMS.

In terms of statistical significance, many questions in the Likert scale indicate a significant difference between management and operations staff. These stress the fact that these two populations, Top Management and Operational Staff, are essentially different. However, few questions have shown that management and operations staff agrees on the following statements:

Agreements

- General agreement on lack of accountability in fulfilling the set objectives and targets.
- General agreement on the benefits of marketing and branding in adopting the EMS through increasing the number of clients and expanding business.

Disagreements

•General disagreement on visibility, accessibility and the well communication of the environmental policy, which means that the environmental policy is evidently not as described above.

•General disagreement whether the aluminium industrial facility set targets and objectives for all the significant environmental aspects including air, water, solid waste, hazardous waste and noise.

The above-mentioned statements are clearly linked to the previously mentioned gaps in terms of environmental training and awareness. Table 1 below lists further the significant and independent factors affecting the obtained responses from a statistical viewpoint.

Case study

In order to confirm the results obtained through the questionnaire, two staff from each population category was interviewed. Two senior engineers/managers and two operations staff were questioned about the EMS implementation at their facility. Two sites were chosen for this case study, referred to as Site 1 and Site 2. At the beginning of the interviews, the purpose of the study was explained to the participants. They were also shown specific survey results to comment on.

The case study confirmed some of the findings highlighted by the questionnaire. It was evident that the EMS experience at both Site 1 and Site 2 vary due to site operational age, where Site 1 is older with more experienced staff than Site 2. The key finding of the case study is manifested in a variance in understanding EMS knowledge between the managers and the operational staff. For example, in regard to awareness programs and training, managers and employees' perspectives were dissimilar due their expectation levels and this explains why many respondents in the survey believe there is a major defect in the environmental communication. As consequence, the knowledge level of operational staff is highly associated with the management visibility and leadership towards the EMS. This can be sensed in the case study where staff environmental awareness and level of technical knowledge at Site 1 is higher than Site 2.

As indicated under the questionnaire section, Managers and operational staff perspectives is different due to various reasons such as lack of communication, level of staff awareness, operational staff education level, and leadership involvement. During the site visit, operational supervisors in Site 2 were less visible on site while operational staff was carrying out their duties. Therefore, lack of supervision, hands-on training and guidance as concluded in both the questionnaire and interviews was demonstrated in the site visit.

The interviews in Site 1 demonstrated in-depth knowledge about the environmental performance compared to Site 2. Through the site visit, further observations were carried out on the advancement of Site 1 and the ability to export technology to other smelters. The utilization of the environmental management tools was also examined through the case study and it was determined that even though measurement and improvement, pollution prevention and resource conservation were practiced on-site, aluminium life cycle assessment, and environmental benchmarking fell short in application. At best, environmental gap analysis and environmental best practice were followed on a relatively smaller scale.

As such, the findings of the case study, site interviews and questionnaire confirmed a substantial need for a holistic framework encompassing the essential elements of an efficient EMS. A strategy for successful implementation of EMS in UAE aluminium industry is much needed to raise awareness and bridge the gaps between the management and operational staff.

A proposed conceptual EMS framework

In this part of the study, an EMS framework is proposed based on the findings in the previous sections. The significant factors affecting the implementation of EMS based on the questionnaire were mapped to the main gaps in the application of the EMS as shown in Figure 8. These gaps were further mapped into three main categories, organizational factors, systemic factors and human factors as explained by the EMS diamond in Figure 9.

The proposed conceptual EMS framework was superimposed on the ISO 14001 EMS conventional framework in Figure 9 to understand the differences in the steps and the complexity of the layered proposed framework. For example, the conventional ISO 14001 EMS framework has a legal framework that is impeded within the planning step while the proposed EMS framework has a legal framework for compliance and enforcement as an independent stand-alone step. This reflects how important the legal framework in the EMS model is. The proposed conceptual model has some similarities to Feng's hypothesis and model [40]. The model confirms that the interaction between the EMS and the following aspects has a positive impact on firm performance: commitment to learning, shared vision, open-mindedness, and knowledge-sharing.

The proposed framework poses similar aspects to Feng's model such as education and learning, knowledge-sharing and shared vision. It is evident that the model discusses learning, leadership commitments through vision, control of human factors as opposed to open-mindedness and knowledge-sharing through environmental awareness and continuous improvement. This conceptual framework draws on the missing aspects of the conventional EMS system and stresses the importance of EMS planning, having a legal framework for EMS compliance and enforcement, commitment from leadership, education and awareness, and human factors management. Figure 10 explains the difference between the conventional EMS framework and the proposed conceptual EMS framework. Additionally, it explains when to engage the added dimensions in the EMS process, such as legal framework and education.

Elements such as EMS planning and clear local legal framework should be established prior to the EMS cycle initiation. In fact, it forms the basis of all industry regulations. If the specific industry is lacking

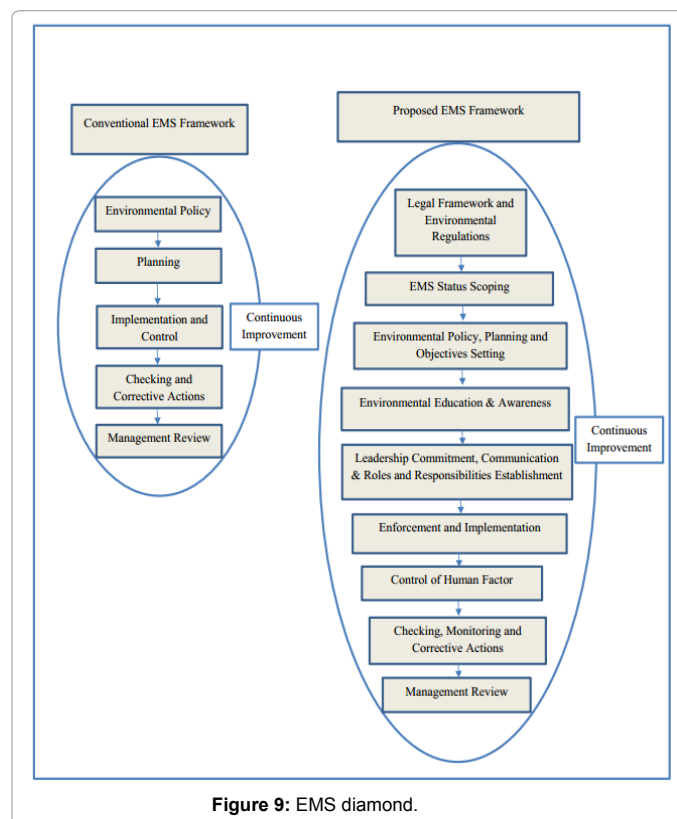


Figure 9: EMS diamond.

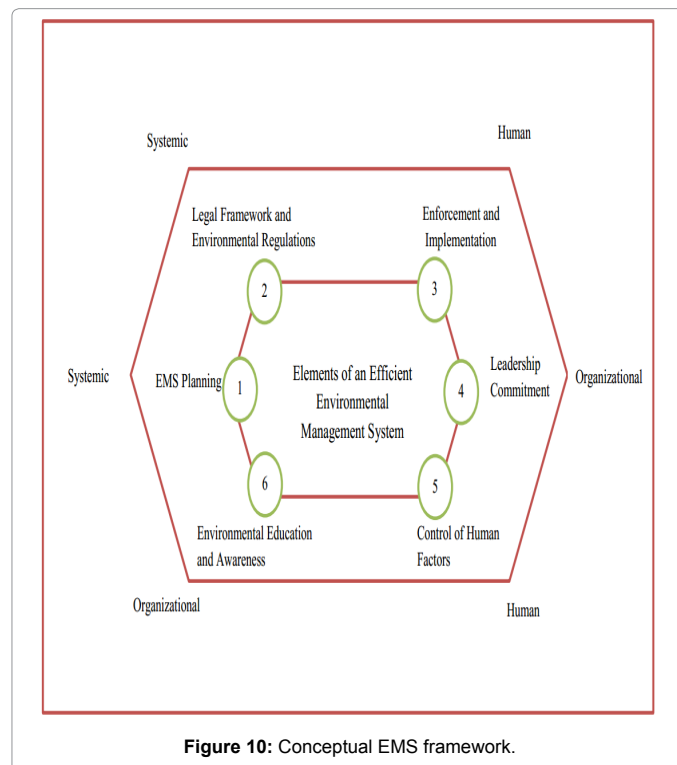


Figure 10: Conceptual EMS framework.

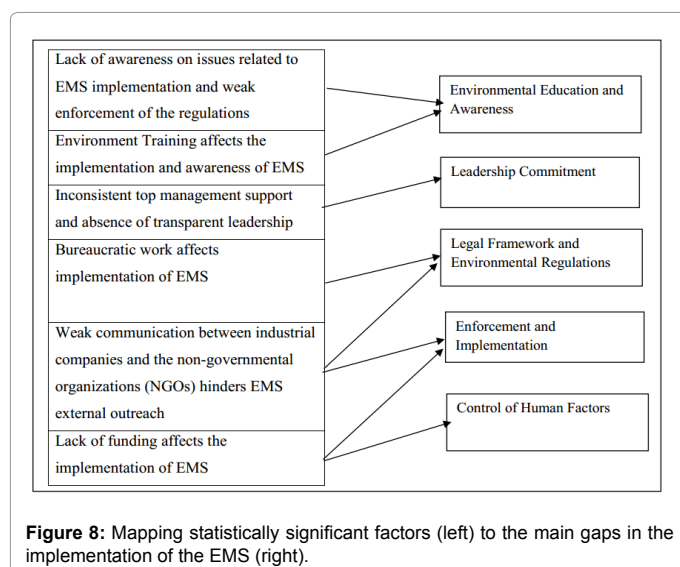


Figure 8: Mapping statistically significant factors (left) to the main gaps in the implementation of the EMS (right).

environmental specific regulations, usually the mother company's regulations or international best practice regulations are followed. Awareness is of vital importance and comes directly from setting a policy for the industry. After the EMS objectives are finalized, leadership should

commit to these objectives. The element of control of human factors is diverse in nature and is continuously monitored. A new perspective is essential to further apply the EMS in the aluminium operational processes.

To understand the steps and the components of the framework, four main questions should be answered:

- What is the framework for?
- How should it be implemented?
- When should it be implemented?
- What are the roles of the industry and the government in implementation of this framework?

The proposed framework has unique features, including incorporation of human, system and organizational factors in the system's building blocks. Through the conducted questionnaire, case study and interviews, the framework of the EMS has been developed as shown in Figure 10 of the EMS diamond. This framework will require the EMS to be more than a paper-based tool or a record-keeping exercise. To measure compliance with this enhanced EMS system, a different method of validation should be used. The auditor should spend considerable time at the plant working with all human subjects and assessing the strength of the system through day-to-day operations, site observations and performance indicators.

The EMS diamond in Figure 10 is structured upon the basic requirements of the conceptual EMS i.e. the actual building blocks of EMS. These 6 essential elements belong to 3 main descriptive groups, which are human, systemic and organizational factors. Human factors

include management of workers, welfare, enforcement and implementation. Organizational factors include education, awareness and leadership commitment. Finally, system factors include EMS planning and having a legal framework and environmental regulations to govern the activities of this sector. The interactions and the interrelations between human, systemic and organizational factors have resulted in the generation of an EMS diamond. As such, Figure 10 is dedicated to answering the question, what is the framework in which it focuses on three vital areas: organizational, systemic and human factors.

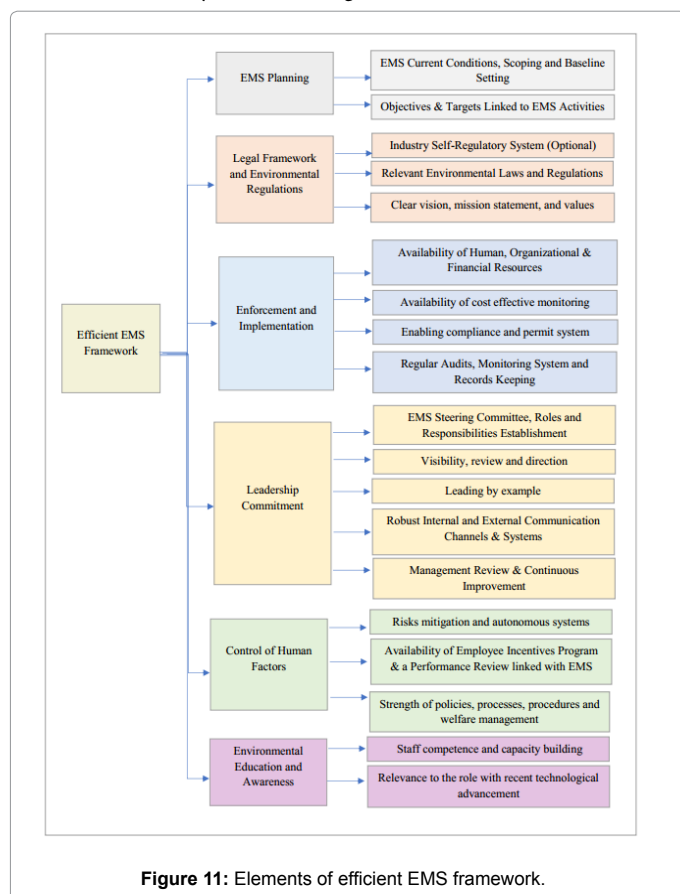
Figure 11 below details the steps of the conceptual EMS system. Figure 11 explains the importance, roles and mechanism between the attributes of organizational factors, systemic factors and human factors in implementing EMS in the workplace. Figure 11 further details the pillars and the elements of an efficient EMS implementation process as follows:

EMS planning: The main two sub-elements of the EMS planning are: EMS current conditions, scoping and baseline setting; and objectives and targets linked to EMS activities. The importance of the EMS planning process resides in identifying the activities of the organization that have significant environmental impacts and mapping those with suitable mitigation requirements. Correct EMS planning reflects positively on the entire EMS experience. The EMS current conditions scoping and baseline setting step is similar to the initial review step of the ISO 14001 EMS. Identifying targets and objectives linked to EMS activities should also be done on the organizational level and not only the EMS level.

Legal framework and environmental regulation: The most essential corner of the EMS diamond is the legal framework and environmental regulations. In order to fulfill the requirements of this corner, the following input are required: an industry self-regulatory system (no public regulator), relevant environmental regulations, and a clear mission statement and values for the organization. This legal framework needs regular evaluation to ensure its effectiveness in solving the industry specific dilemmas and technical constraints. Moreover, a tailored vision, mission and values should be established for the organization. The vision, mission and values should embed environment agenda into the main company's industry stream to be used as a steering mechanism for further guiding the strategic direction of the company.

Enforcement and implementation: Two of the major gaps of all regulatory and compliance systems are enforcement and implementation. Availability of manpower, equipment, management direction, enforced regulations and compliance monitoring are essential for implementing the requirements of a regulatory system. In many cases, the legal regulatory framework is well-established. The weakness, however, lies in the enforcement and implementation methodology. There are mainly four outputs to empower enforcement and implementation of the regulatory system: availability of human, organizational and financial resources, availability of cost effective monitoring, enabled compliance and permit system and regular audits and records keeping. These alone may not suffice but will aid in focusing resources to enforce regulations more effectively. Other tools that can be used to maintain enforcement efforts include risk assessment of certain industries and history of violations obtained in specific companies.

Leadership commitment: The new revision of the ISO 14001 has identified leadership commitment as an independent clause to highlight and emphasize the role that leadership plays in the EMS. The standard also eliminated the need to have environmental management representative but ensured that this role is embedded in the organizational



structure of the facility [41]. The main pillars of leadership commitment requirements are an EMS steering committee, roles and responsibilities establishment, visibility, review and providing direction, along with leading by example, robust internal and external communication channels and systems, management review and continuous improvement. These elements constitute strong leadership commitment to the vision, mission and objectives of the organization. Leadership commitment influences the EMS efficiency directly. The more committed the leadership is to their environmental objectives, the more efficient and transparent the environmental management system implementation processes are.

Control of human factors: Scholars consider the control of human factors an important pillar of the EMS [42,43]. Human factors are mainly any internal or external influences that affect human behaviour. Pertaining to EMS, human factors include reduction of environmental risks to an acceptable level (ALARP), i.e. reduction of human errors that causes environmental accidents. The three main elements that contribute in the control of human factors function are:

- Risk mitigation and autonomous systems.
- Availability of employee incentive program and performance review that is linked to EMS.
- The strength of policies, processes, procedures and welfare management.

An efficient EMS relies heavily on the control of human factors through strong policies and procedures and welfare management, employee incentive program and EMS linked performance management along with risk mitigation and autonomous systems that reduce the reliance on human for sensitive operations. It is important to remember that employees' welfare plays a significant role under the policies and procedures of an organization and it can only result in an improved EMS implementation process.

Environmental education and awareness: The final pillar of an ef-

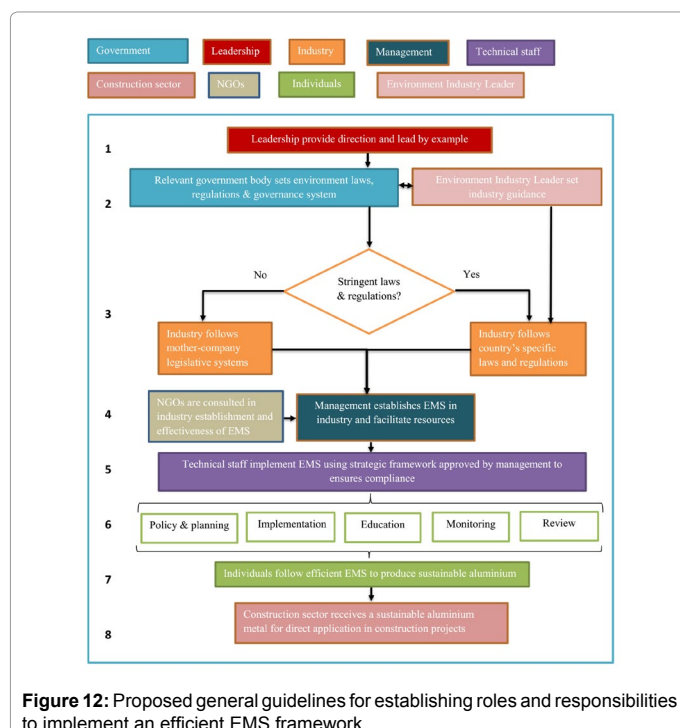


Figure 12: Proposed general guidelines for establishing roles and responsibilities to implement an efficient EMS framework.

ficient EMS is environmental awareness. It is essential to have a strong and regularly updated awareness program for a successful EMS experience. Staff should be trained on understanding the environmental policies, procedures, environmental aspects, impacts and mitigation measures related to their line of work. Moreover, they should learn how to achieve environmental compliance objectives and what their roles are in this regard. This is detailed in the ISO 14001 EMS requirements where training records should also be kept [44]. The main two elements of environmental awareness for an organization are staff competence and capacity building and relevance of the training to the role with recent technological advancement in the field. Staff competency, capacity building, tailored environmental training for technical staff and recent technological advancement to the field is important aspects to consider while planning the training within the organization.

Figure 12 explains a general guideline for the industry, government, organizations, leadership, management, and NGOs to understand their roles in the efficient EMS cycle, where:

First, leadership at the highest level provides direction and leads by example when it comes to issues related to environmental management and sustainability practices. Leadership in UAE at the highest level has set a standard of excellence in the environmental protection and performance. The late Sheikh Zayed bin Sultan Al Nahyan, founder of UAE, has placed the environment at the top of all agendas to be pursued. He said: **“On land and in the sea, our fore-fathers lived and survived in this environment”**. They were able to do so because they recognized the need to conserve it, to take from it only what they needed to live, and to preserve it for succeeding generations [45].

Second, relevant government bodies set laws, regulations, policies and governance systems. Examples of government bodies of relevance are the Ministry of Climate Change and Environment (MoCCE) at the federal level and the Environment Agency-Abu Dhabi (EAD) at the local level. The main law that governs environmental protection and development in UAE is Law No. 24 of 1999. However, the current gaps lie in the enforcement of the law and monitoring activities. The role of the environment industry leader when there is lack of governance system in the country of operations is emphasized. The environment industry leader sets industry guidance, in absence of strong governance system for environmental laws, and regulations.

Third, if the environmental laws and regulations are stringent in the country, then the organization will comply with them. If not, then the organization will follow the rules, regulations and legislative system of the industry's mother-company, which is usually tailored to the need of the industry.

Fourth, the industry management establishes the EMS in the organization and facilitates resources. This can be done concurrently with the NGO's consultation process over the industry establishment and the effectiveness of EMS in tackling the environmental concerns of the industry.

Fifth, the technical staff implement the EMS using strategic framework approved by management, whether ISO 14001 or other systems, to ensure compliance.

Sixth, the pillars of the efficient EMS include Policy and Planning, Implementation, Education, Monitoring and Review.

Seventh, the individual staff follows the EMS to produce sustainable aluminium.

In the **Eighth** and final step, the construction sector receives the

sustainable metal for direct application in the construction projects.

Conclusion

This study aims at evaluating Environmental Management Systems (EMS) in the UAE aluminium industry to understand the external and internal factors affecting the implementation process of an EMS.

To achieve a sustainable metal production process, the EMS tool was used to measure compliance in the environmental management of aluminium. An industry specific questionnaire was developed to identify areas of strength and weakness of the existing EMS practices at the UAE aluminium industry. The questionnaire was distributed across the aluminium industrial sector in the UAE and responses were collected.

371 questionnaire responses, representative of the population, were collected, analyzed and verified statistically to identify significant and independent factors affecting the implementation of an EMS. There is a significant difference between management and operations staff in the responses. The two sections of the population, management and operational staff, are essentially different in their interpretation of the EMS experience. A specific environmental training dedicated to the type of work practiced by the employees was also lacking in the aluminium industry, where a generalized environmental training is often delivered. Moreover, the responses indicated a lack of robust governance and enforcement systems, industry-specific laws and regulations, and permitting and compliance follow-up mechanisms.

The most evident external factor impeding the implementation of the EMS is bureaucratic work, followed by lack of support and weak enforcement. Internal factors affecting the implementation of the EMS are mainly inconsistent top management support, low awareness of EMS objectives and reluctance to change traditional practices due to disruption and high cost. The case study was conducted in two aluminium smelter locations in the UAE, referred to as Site 1 and Site 2, in order to verify the questionnaire responses. Case study interviews were conducted with both managerial and operational staff representatives at two aluminium industry location sites. The interview responses steered the conclusions and verified the assumption made on the status of the existing EMS at the facilities. One of the case study sites had a superior and comprehensive EMS experience due to experience gained since the early years of establishment. It was concluded that the implementation of EMS in the UAE aluminium industry is heavily affected by a gap in regulatory compliance enforcement, leadership transparency, accountability, and human factors.

The questionnaire, the case study and its relevant interviews provided converging outcomes, which have been combined and analyzed to propose an integrated framework for efficient implementation of the EMS. In the second section of the study, a conceptual EMS was proposed, based on an integrated framework. The proposed integrated framework included organizational, human and systemic elements as essential framework building blocks. Moreover, the differences between the newly updated version of ISO14001:2015 and this proposed framework are mainly in areas of leadership role, context of the aluminium industry globally and locally, scope, complexity of records keeping, adoption status and audit follow up, among other factors. The proposed framework includes an industry guidance of the roles and responsibilities of different stakeholders, including government, private sector, internal staff and non-profit organizations, in ensuring efficient EMS implementation experience. The framework was validated using interviews and observations where the case study specifically reshaped the framework and provided useful feedback. Afterwards, two external industry professionals subsequently provided valuable feedback on the

efficiency and applicability of the proposed framework. The framework is unique as it provides a foundation for the environmental management in the facility and it understand the gaps present in the aluminium production process. Frequently, health and safety elements of the management system are weighed higher than environmental elements due to their sensitivity and human health value. Therefore, it is important to separate the environment aspects from the health and safety aspects so that they are not compromised or partially weighed in favour of other elements of the management cycle. The feedback received has been categorized, evaluated, analyzed and considered for update to the proposed EMS.

It is essential to test the applicability of this proposed EMS framework in the field to better understand the constraints and opportunities that the new EMS framework provides. The continuous improvement element offers allows for enhancements and upgrades to the system. In addition, the feedback received from evaluators, both external and internal, validated the applicability, functionality and advantages of this new proposed framework by highlighting the shortcomings of the existing EMS processes. The feedback also served as an aid to benchmark the framework to the ISO 14001:2015 EMS implementation process.

Limitations of the study

It is worth noting that this study commenced in 2013 before the release of the new ISO 14001:2015 update. Clearly, the need of such study was evident at the research proposal stage as the ISO 14001:2004 version has revealed many major implementation gaps among professional practitioners. However, as the research progressed, the updated ISO 14001:2015 was released in 2015 and was compared to the proposed EMS framework suggested by this study. It has been noticed that both frameworks shared similar concepts and high-level approach, with differences in the structure of few elements, which only confirms the integrity of the results and findings leading to similar conclusions. The main EMS gaps highlighted by this study were addressed differently in both frameworks. Therefore, this study confirmed the existing gaps at the UAE aluminium industry with regard to environmental management systems.

A limiting factor to this area of study is the access to the aluminium industry's environmental data. It was difficult to obtain environmental data due to its sensitivity and confidentiality nature. These data directly affect the company's environmental image and reputation. The data utilized in this study is mainly from published environmental materials such as the companies' sustainability reports and testimonies from personnel working within the industry. In addition, framework quantitative validation process employed the use of previous environmental data rather than current environmental data.

The study did not take into consideration the environmental impacts embodied in the imported raw materials for the UAE aluminium industry as such impacts are local for the country of operation. The focus of the study is within the UAE geographical boundary; therefore, a trans-boundary approach to understand cradle to grave environmental impacts of the aluminium industry was considered outside the scope of this study.

Finally, this study did not focus on the production of secondary aluminium through recycling of aluminium construction waste, which is considered 92 percent more energy efficient than the primary aluminium production process [46]. The study focused on high environmental impacts manufacturing processes ensuring that these impacts are well-addressed and mitigated through the EMS cycle.

It is hoped that presented methodology of assessing the sustainability of the aluminium as a metal by looking at its manufacturing practices and its supply chain management may create a precedent in the way conventional construction; environmental and sustainability issues are tackled.

Recommendations

The outcome of this study adds a significant value to the conventional EMS systems in the aluminium industry. Further recommendations for following up this research work can be summarized as follows:

- Creating a stringent legal framework and relevant environmental regulations that are able to guide the aluminium industry in the UAE.
- Cumulatively evaluating the Environmental Management System (EMS)

practices for all available aluminium production and recycling stages within the UAE.

- Creating an aluminium life cycle inventory for individual aluminium industries to feed into the overall life cycle assessment process.
- Testing the proposed framework after implementation in the UAE aluminium industry.
- Linking environmental planning aspects with environmental management outcomes for the UAE aluminium industry.

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